

THE CLAIMS

What is claimed is:

1. A method for fabricating a carrier substrate comprising:
providing a crystalline or mono-crystalline base substrate;
growing a stiffening layer on a front face of the base substrate at a thickness sufficient to form a carrier substrate for subsequent processing; and
detaching the stiffening layer from the base substrate to obtain the carrier substrate and a remainder of the base substrate, the carrier substrate being suitable for use in growing high quality homo-epitaxial or hetero-epitaxial films thereon.
2. The method of claim 1 wherein the front face of the base substrate is detached with the stiffening layer to form a sub-layer of the carrier substrate.
3. The method of claim 2 which further comprises implanting atomic species into a front face of the base substrate to a controlled mean implantation depth to form a zone of weakness within the base substrate that defines the sub-layer.
4. The method of claim 3 wherein the atomic species are at least one of hydrogen ions and rare gas.
5. The method of claim 3 wherein the implanting step occurs before growing the stiffening layer.
6. The method of claim 1 wherein the sub-layer is less than approximately 5 μm thick.
7. The method of claim 1 which further comprises conducting a thermal treatment to detach the carrier substrate from the base substrate.
8. The method of claim 3 which further comprises providing a sacrificial layer on the front face of the base substrate prior to implanting atomic species.

9. The method of claim 8 wherein the sacrificial layer is a thin silicon dioxide (SiO_2) layer.
10. The method of claim 8 which further comprises removing the sacrificial layer before providing the stiffening layer.
11. The method of claim 1 which further comprises growing the stiffening layer by at least one of epitaxial growth, molecular beam epitaxy (MBE), metal-organic chemical vapor deposition (MOCVD), hydride vapor phase epitaxy (HVPE) or by sputtering.
12. The method of claim 1 wherein the stiffening layer is in the range of approximately 5 μm to at least approximately 10 μm thick.
13. The method of claim 1 which further comprises pre-treating the surface of the base substrate prior to growing the stiffening layer by using at least one of HF etching, plasma etching, or a standard cleaning treatment.
14. The method of claim 1 which further comprises providing at least one additional layer on top of the stiffening layer or between the base substrate and the stiffening layer.
15. The method of claim 14 wherein the additional layer between the base substrate and a stiffening layer is a buffer layer, the buffer layer being made of at least one of AlN, GaN, AlGaN or a combination thereof.
16. The method of claim 3 further comprising providing at least two additional layers on top of the base substrate, and wherein at least one of the additional layers is provided prior to implanting atomic species.
17. The method of claim 16 which further comprises implanting the atomic species into the at least one additional layer to create a weakened zone inside the at least one additional layer.

18. The method of claim 1 which further comprises polishing a surface of the remainder of the base substrate after detaching the carrier substrate such that the base substrate is suitable for reuse.

19. The method of claim 1 wherein the base substrate is made of at least one of silicon, silicon carbide, sapphire, gallium arsenide, indium phosphide (InP) or germanium (Ge).

20. The method of claim 1 wherein the stiffening layer is epitaxially grown and is made of the same material as an epitaxial film to be grown on the carrier substrate in a subsequent fabricating step.

21. The method of claim 1 wherein the stiffening layer has a crystalline structure and a thermal expansion coefficient similar to that of an epitaxial film to be grown on the carrier substrate in a subsequent fabricating step.

22. The method of claim 1 wherein the stiffening layer is made out of at least one of gallium nitride (GaN), aluminum nitride (AlN), indium nitride (InN), silicon germanium (SiGe), indium phosphite (InP), gallium arsenide (GaAs) or alloys made out of those materials.

23. The method of claim 22 wherein the alloys include at least one of AlGaN, InGaN, InGaAs or AlGaAs.

24. The method of claim 1 wherein a backside surface of the carrier substrate created after the detaching step has a surface roughness in a range of approximately 20 to about 200 Å RMS.

25. The method of claim 1 further comprising growing an heteroepitaxial film on the carrier substrate.

26. The method of claim 25 wherein the heteroepitaxial film is made out of at least one of GaN, SiGe, ALN or InN.